# Training theory of mind following right hemisphere damage: A pilot study

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## Abstract:

Successful communicative interactions in large part rely on an ability to infer the mental states of conversational partners. Understanding other people's mental states, such as thoughts, beliefs, and emotions, allows us to understand and predict their behaviors. Mental states are often described in terms of two components of a "Theory of Mind" (ToM): first-order beliefs, that is, what a person believes about the world, and the more complex second-order beliefs, that is, what one person believes about the mental state of another person. Theory of Mind (ToM) deficits have been reported in individuals subsequent to RHD as well as in other populations such as autism and patients with prefrontal lesion (Baron-Cohen et al., 1985, Happe et al., 1999 and Stone et al., 1998). Theoretical accounts consider ToM in relation to, for example, executive function or empathy, or as a relatively independent cognitive ability.

**Keywords:** Cognitive ability | Mental state | Theory of Mind

## Article:

### Introduction

Successful communicative interactions in large part rely on an ability to infer the mental states of conversational partners. Understanding other people's mental states, such as thoughts, beliefs, and emotions, allows us to understand and predict their behaviors. Mental states are often described in terms of two components of a "Theory of Mind" (ToM): first-order beliefs, that is,

what a person believes about the world, and the more complex second-order beliefs, that is, what one person believes about the mental state of another person. Theory of Mind (ToM) deficits have been reported in individuals subsequent to RHD as well as in other populations such as autism and patients with prefrontal lesion (Baron-Cohen et al., 1985, Happe et al., 1999 and Stone et al., 1998). Theoretical accounts consider ToM in relation to, for example, executive function or empathy, or as a relatively independent cognitive ability.

**Outline of intervention program**

We have developed a structured training program to facilitate ToM performance in RHD patients. The training is based on a simple model for representing the mental states of others through the use of thought-bubbles (Wellman et al., 2002). Thought-bubbles provide a graphic, completely explicit, visual means to represent the mental states of individuals and provide support for comparing and contrasting the mental states of more than one individual at a time. This mode of graphic display is well within the visuospatial abilities of the vast majority of brain-injured patients. The graphic format is a simple visual presentation consisting of one or two characters within a two-story house with lines attached from characters to their own individual thought-bubbles. Characters observe objects and changes in objects.

The intervention program follows the outlines of a single subject experimental design. We began by administering the Cognitive and Linguistic Quick Test (Helm-Estabrooks, 2001), a brief test of executive function, and the Empathy Quotient (Baron-Cohen & Wheelwright, 2004), a self report measure of empathy, followed by a series of baseline assessments to document stable performance prior to initiation of training. We then administered a series of tasks to target different components of ToM for remediation and assessment. The training items were presented using one and two characters with bubbles placed above their heads to depict their thoughts about a variety of objects. The patient determines the thoughts of the character, as they relate to the object and, in some situations, to the beliefs of another character in the house. The patient is then asked to predict behavior based on the relevant mental state(s). The program begins with first-order beliefs and progresses to include second-order beliefs.

The program is designed to support mental state operations that tap (1) difficulty generating thoughts about pictured objects from another's perspective; (2) difficulty evaluating the thoughts of one or two characters as objects change form and the characters change location within the house; (3) difficulty evaluating differences between characters' thoughts and their eventual actions; and (4) difficulty inhibiting personalized thoughts, unrelated to the characters. Different patients may have difficulty with one or more than one component, reflecting the complexity of this task.

**Patients and results**

We have used versions of the ToM intervention program with two RHD patients. The first patient, P-1, is a 62-year old, right-handed man with a masters degree and a tested IQ that places

him in the superior range. P-1 is 20 years post occlusive cerebrovascular event that left him with a large right parietal-temporal-frontal lesion, with no noted left-sided injury. His neuropsychological history includes left neglect shortly after his stroke that has almost completely resolved. P-1 presents with memory and language skills within normal limits for his age, mildly impaired executive function and visuospatial skills, and moderately impaired attention. Interpersonally, P-1 displays many of the characteristics associated with right-sided disease: a subtle denial of deficits, occasional inappropriate remarks, a tendency to personalize tasks, an inclination towards literal interpretations, and a lack of empathy.

P-2 is a 60-year-old, right handed man with 12 years of education and a tested IQ that places him in the average range. He is 5 years post a right middle cerebral area infarct with no noted left-sided injury. His neuropsychological history includes a mild left neglect shortly after his stroke that has almost completely resolved. P-2 presents with memory and language skills within normal limits for his age, severely impaired executive function, mildly impaired visuospatial skills, and moderately impaired attention. In social conversation P-2 displays occasional inappropriate remarks, a tendency to personalize tasks and conversations, and difficulty understanding figurative language.

Preliminary results indicate, first, that significantly impaired RHD patients are capable of carrying out all of the component tasks and find the training sufficiently interesting to remain with the protocol. Second, both patients who are in the final stages of training have displayed clear evidence of response to the training, as demonstrated by their ability to reach criterion on training tasks. After completion, we will test for associations between change in ToM performance and changes in executive function and empathy.

**Implications**

The results will offer the potential to improve ToM performance in patients with RHD even years post stroke, and will provide a different approach to building our understanding of how ToM capacity relates to other components of cognition.

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